PREFABRICATED PASSIVE HOUSE VENTILATED FAÇADE PANEL SYSTEM WITH RECYCLED CONCRETE

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ABSTRACT
Presented prefabricated façade system is possibility for affordable, cost effective, healthy and sustainable solution that is implemented on the three various architectural designs that are in different phases of design development. This ventilated prefabricated wall panel system that is called ECO-SANDWICH® is energy efficient, recycled concrete sandwich façade panel. It is R&D project that was funded by the European Commission within the framework of CIP-EIP-Eco-Innovation 2011 Programme. Encourage the re-use and recycling of construction and demolition waste (CDW) in order to shift CDW management from disposal to recycling and reduce utilisation of natural resources thus preventing landscape degradation. Three priorities of the EU Eco-innovation call are incorporated; it uses recycled material to create innovative sustainable building product which contributes to healthy building, it represents a significant improvement over the existing prefabricated wall panel products, aligning itself with the mandatory targets of EPBD, its Recast EPBD II and with EU Waste Framework Directive. The system is affordable solution both for the new construction and renovation up to “factor 10” and it is marked as “the green revolution in construction”. The very first three projects designed by architect Lj. Miščević based on this façade system are presented. The Central Building of the University Campus, the reuse renovation project for the University library and the type family house for social housing standard all in the town of Koprivnica. Energy concept for all of them is nearly zero energy building (nZEB). More precise, it is passive house energy standard (A+) with active renewable energy systems. It is affordable in social housing in Croatia as it is proved in the three realized multi-family buildings.

Keywords: prefabricated façade panels 1, eco-innovation 2, energy efficiency 3, nearly zero energy buildings 4, new buildings and efficient refurbishment 5.
INTRODUCTION

The concept incorporates three priorities of the eco-innovation call; it uses recycled material to create innovative sustainable building product which contributes to greening the business of SMEs through decreasing their environmental impact accompanied by the use of less non-renewable or natural resources, and energy efficiency to Nearly zero energy building (nZEB). ECO-SANDWICH project encourages the re-use and recycling of construction and demolition waste (CDW) in order to shift CDW management from disposal to recycling and reduces utilisation of natural resources.

Therefore this way prevents landscape degradation, promotes the substitution of conventional thermal insulation materials by mineral wool produced using innovative and sustainable technology, leading to a reduced environmental impact. It also promotes the implementation of prefabricated, energy efficient products in order to enable reduction of primary energy consumption in residential and commercial buildings and reduce embodied energy, embodied carbon and production of by-product wastes. Therefore this way prevents landscape degradation, promotes the substitution of conventional thermal insulation materials by mineral wool produced using innovative and sustainable technology, leading to a reduced environmental impact.

ENVIRONMENTAL, TECHNICAL AND TECHNOLOGICAL CHARACTERISTICS

Figure 1: European key messages tackled by the ECO-SANDWICH project, 3D model and real section.

SUSTAINABILITY CONSIDERATIONS

Innovative concreting solution of outer layer distinguishes prefabricated ECO-SANDWICH (ES) wall panels from similar products and makes it unique on the
market. This façade panels system represents improvement of existing prefabricated wall panel products, aligning itself with the mandatory targets of EPBD and EPBD II. thus tackling the 20-20-20 targets (20% reduction in EU greenhouse gas emissions from 1990 levels; raising the share of EU energy consumption produced from renewable resources to 20%; 20% improvement in the EU’s energy efficiency), and represents a possible technological solution for fast construction of very low energy or passive house standard (A+) buildings on a large scale. The ES tackles three major environmental problems; reducing greenhouse gas emission by enhancing energy efficiency of buildings, increased resource efficiency through the use of construction and demolition waste (50% of total aggregates is obtained from recycled aggregate) in panel manufacturing and minimising the use of regulated chemicals like phenol and formaldehyde from the insulation material production process. The embodied energy of the ES is 33.8% lower than that of lightweight composite insulation panels such as those made of aluminium or galvanized sheets and polyurethane insulation. Moreover, the ES wall system has greater thermal mass. ES wall panels are both reusable and fully recyclable. Abiding by the credo that “the best energy is saved energy”, the ECO-SANDWICH achieves sustainable, healthier environment and living ambient for occupants. Taking into account that mechanical recycling and crushing of CDW consumes only small amount of energy and is an environmentally friendly process, the ES, by using recycled CDW in combination with mineral wool produced with Ecose® Technology, constitutes an innovative product whose embodied energy payback time is 22 months due to savings during exploitation.

ENERGY EFFICIENCY

Buildings are one of the greatest consumers of energy, thus having a great environmental impact, apart from the energy consumption but because of the significant impact of construction materials to the environment during production, manifesting through its embodied energy, and disposal. The present condition of the existing building stock in EU is deeply unsatisfactory. Most buildings are ‘sub-standard’ in terms of energy efficiency, comfort and health. In EU buildings consume around 40 % of energy needs and account for 36 % of EU’s CO2 emissions. Therefore, these countries have decided to implement plans to increase energy efficiency in their national energy strategies and to develop legal framework for the implementation of these plans.

Thermal conductivity of the concrete made by using the recycled concrete and recycled brick as aggregates are 36 % and 45 % lower, respectively, in comparison with the thermal conductivities of concrete using aggregates form nature. Thermal transmittance of the ES wall panels is U<0.20 W/m²K
CIP ECO-INNOVATIONS

Project “Energy Efficient, Recycled Concrete Sandwich Facade Panel – ECO-SANDWICH” has been recognized, and is being financed within the framework of CIP-EIP-Eco-Innovation 2011 programme. It has been accepted for financing together with 47 other projects among 280 proposals, in total. Launched in 2008, the Eco-innovation initiative is part of the EU’s Entrepreneurship and Innovation Programme (EIP), set up to support innovation among SMEs and to improve their competitiveness. It is included in the EIP’s annual work programmes.

The Eco-innovation initiative bridges the gap between research and the market. By co-funding 50% of the projects, European commission helps good ideas for innovative products, services and processes that protect the environment become fully-fledged commercial prospects, ready for use by business and industry. In doing so the initiative not only helps the EU meet its environmental objectives but also boosts economic growth.

![Figure 2: Potential market size for uptake of the ECO-SANDWICH wall system.](image)

THE FIRST PROJECTS FOR IMPLEMENTATION

By implementing ECO-SANDWICH wall panel system, new business possibilities are emerging, together with promoting innovative and green economy, for building new or refurbishing existing various architectural functional types as apartment buildings, family houses, office buildings, schools, hospitals, production and storage facilities, farms etc.

The first projects for this façade system implementation are designed for Central building as new building and one reuse refurbishment for University and public library both in the University campus in the town of Koprivnica in Croatia. The very last one that is now in the process of Main project is for the first family house from the Social housing program (POS) in the same town. All projects are designed on the passive house standard (A+). Author of those projects is architect Ljubomir Miščević.
Figure 3: Project for the Central building of the University campus in Koprivnica, Croatia. 3D models of the view from south-east and north-east. North-west elevation. Author: Lj. Miščević, 2013.

Figure 4: University and public library in University campus in Koprivnica, Croatia. Idea project for reuse and reconstruction. Author Lj. Miščević, 2013. 3D models of existing state and Idea project. South and east elevation. Energy eff. renovation up to “factor 10”.
CONCLUSIONS

Ventilated prefabricated wall panel presented in this paper utilises recycled construction and demolition waste (CDW) and mineral wool produced using innovative and sustainable technology for reduction of primary energy consumption in building stock. The results of EU Eco-innovation research project titled ECO-SANDWICH represents a significant improvement over the existing prefabricated wall panel products, aligning itself with the mandatory targets of the EU; Energy Performance of Buildings Directive - EPBD, its Recast EPBD II. and Waste Framework Directive targets. Presented projects for the first implementations are more better in energy efficiency than it is defined as national nearly zero energy level (nZEB). They are A+ passive house so they figure pilot projects for the new platform of social, affordable, energy efficient and sustainable building referent for creation of passive healthy cities and regions.

REFERENCES


